Patent Claims:

1. An erythropoietin (EPO) form having improved properties, wherein said EPO form is

(a) a fusion protein comprising a Fc portion of an Ig molecule and an EPO molecule (Fc-EPO), wherein said Fc portion is fused covalently via its C-terminus directly or indirectly to said EPO molecule and wherein the Fc portion as well as the EPO portion may be modified or mutated, selected from the group:

(i) Fc - EPO
(ii) Fc – L - EPO
(iii) Fc – EPO_{desial}
(iv) Fc – EPO_m
(v) Fc_m – EPO
(vi) Fc_m - EPO_m
(vii) Fc_m – L – EPO
(viii) Fc – L – EPO_m
(ix) Fc – EPO_{trunc}
(x) Fc – L – EPO_{trunc} wherein

EPO is glycosylated, non-glycosylated, partially glycosylated or otherwise modified in its glycosylation pattern;
EPO_{desial} is EPO which is partially sialylated or non-sialylated;
EPO_m is EPO which is mutated but not truncated in its amino acid sequence;
EPO_{trunc} is EPO which is truncated but not mutated in its amino acid sequence;
Fc_m is a Fc portion which is mutated and / or truncated in its amino acid sequence and / or modified in its glycosylation pattern, and
L is linker molecule which has no protease cleavage site,
or

(b) a non-fused human or mammalian EPO or EPO_m having the pattern of cysteines or disulfide bonds that differs from the pattern of cysteines or disulfide bonding of human or mammalian EPO.

2. An EPO form of claim 1, showing improved biological activity.

3. An EPO form of claim 2 having an extended serum half-life

4. An EPO form of claim 3, wherein said extended serum half-life is greater than 20 hours.

5. The fusion proteins (iv), (vi) or (viii) of claim 1, wherein said fusion proteins have greater specific activity than the comparable Fc-EPO fusion proteins having no mutated EPO molecules.

6. A fusion protein of claim 5, wherein in the EPO_m portion at least one of the following changes is achieved:
$Asn_{24, 38, 83} \rightarrow Gln$, $Ser_{126} \rightarrow Ala$, $His_{32} \rightarrow Gly$, $Ser_{34} \rightarrow Arg$, $Pro_{90} \rightarrow Ala$.

7. The fusion proteins (ix) and (x) of claim 1, wherein EPO_{trunc} has an amino acid sequence which ends C-terminally with the amino acid positions 108, 98, 93, 88, 85 or 77 of EPO or EPO_m.

8. A fusion protein of claim 1, wherein the mutation of the Fc_m portion causes reduced affinity to Fc receptors.

9. A fusion protein of claim 1, wherein the linker L is $(Gly_4Ser)_x$, x = 1 – 4.

10. A fusion protein of ~~any of the claims 1 - 9~~ Claim 1, wherein at least one of the cysteine residues of the EPO molecule or EPO_m molecule is engineered.

11. A fusion protein of claim 10 wherein the EPO moiety has a pattern of disulfide bonding distinct from human or mammalian erythropoietin.

12. A fusion protein of claim 10 or 11 or a non-fused EPO of claim 1, wherein the EPO includes at least one of the following amino acid variations: position 29 is not Cys, position 33 is not Cys, position 88 is Cys, position 139 is Cys.

13. A fusion protein or a non-fused EPO of ~~any of the claims 10 - 12~~ Claim 10, wherein said engineered cysteine residues form a disulfide bond.

14. A fusion protein or a non-fused EPO according to claim 12 ~~or 13~~, wherein the EPO is derived from human EPO and has at least one of the following mutations: $His_{32} \rightarrow Gly$, $Ser_{34} \rightarrow Arg$ and $Pro_{90} \rightarrow Ala$.

15. A fusion protein according to ~~any of the claims 1 – 14~~ claim 1, wherein the EPO portions or EPO_m portions within the Fc fusion protein are dimerized.

16. A fusion protein according to ~~any of the claims 1 – 15~~ claim 1, said fusion protein being a whole Ig molecule.

17. A fusion protein according to ~~any of the claims 1 – 16~~ claim 1, wherein the Ig molecule and the EPO molecule is of mammalian origin.

18. A fusion protein of claim 17, wherein the Ig molecule is human IgG.

19. A DNA sequence encoding any of the EPO forms of ~~claims 1 – 18~~ claim 1.

20. A DNA molecule encoding a fusion protein of claim 1 comprising:
(a) a signal / leader sequence
(b) a Fc region of an Ig molecule
(c) a target protein sequence having the biological activity of erythropoietin.

21. An expression vector comprising a DNA of claim 19 ~~or 20~~.

22. A host cell suitable for expressing an EPO form as defined in claim 1 comprising a vector of claim 21.

Sub A3
Sub B1

23. A method for producing a fusion protein of claim 1, said method comprising:
(i) constructing a DNA encoding a precursor protein that comprises from N-terminus to C-terminus a leader sequence for secretion, the Fc portion and the EPO, EPO_m or EPO_{trunc},
(ii) placing said fused DNA in an approbiate expression vector,
(iii) expressing said fusion protein in a eukaryotic cell, and
(iv) purifying said secreted fusion protein.

24. A pharmaceutical composition comprising an EPO form according to ~~any of the claims 1-18~~ Claim 1 and an phamaceutically acceptable carrier, diluent or excipient.

25. A pharmaceutical composition of claim 24 containing at least one additional pharmaceutically effective drug and / or adjuvants.